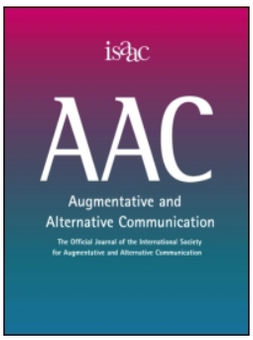

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RESEARCH ARTICLE

The profiles of students with significant cognitive disabilities and complex communication needs

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ABSTRACT

Understanding the characteristics of students with complex communication needs and significant cognitive disabilities is an important first step toward creating the kinds of supports and services required to help them successfully access the general education curriculum, achieve grade-level standards, and improve overall communication competence. The First Contact Survey was designed to collect important information about students with significant cognitive disabilities who were eligible to take the Dynamic Learning Maps™ (DLM®) alternate assessment based on alternate achievement standards. From November 2012–May 2013, the survey was used to gather information regarding more than 44,787 students. At that time, the goal was to use the data to inform the development of the DLM assessment. Although the survey includes a wealth of information regarding this large sample of students, the reanalysis of the data reported in the current study focused on the motor, sensory, language, reading, and writing skills of students with significant cognitive disabilities, based on their speech production abilities. Significant differences were identified across each of the domains between students who do and do not use speech with or without aided augmentative and alternative communication.

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Introduction

Communication impacts all aspects of a school day and is essential for learning. Effective communication can take the form of spoken words, gestures, sign, aided augmentative communication, or any combination thereof. Students with complex communication needs require supports that promote successful participation and learning especially as they work to access the general education curriculum and achieve academic standards. When students with complex communication needs also have significant cognitive disabilities, the demands for supports are intensified. Understanding the characteristics of students with complex communication needs and significant cognitive disabilities is an important first step toward creating the kinds of supports and services they require.

Students with Significant Cognitive Disabilities

Definition. Significant cognitive disabilities is a term coined by the U.S. Department of Education (2005) to describe a group of students who receive special education services under a variety of eligibility categories (e.g., autism, intellectual disability, multiple disabilities, etc.) and who have cognitive disabilities that prevent them from achieving grade-level standards, even with the very best instruction and appropriate accommodations. In the US, more than 90% of students with significant cognitive disabilities are educated in separate special education classrooms or schools (Kleinert et al., 2015). States set their own guidelines regarding which students may be classified as having a significant cognitive disability (Albus & Thurlow, 2012), and Individualized Education Program teams make the final determination (See IDEA, 2004 sections 612(a)(16) and 614(d)(1)(A)(i)(VI)). As a result, students with significant cognitive disabilities are a diverse group that generally requires: (a) extensive, repeated, individualized instruction and support, (b) substantially adapted and modified materials, and (c) individualized methods of accessing information to acquire, maintain, generalize, demonstrate and transfer skills across settings (Erickson, 2013). In the US, the determination is linked to participation in an alternate assessment based on alternate achievement standards rather than the general assessments that are mandated for all students in public schools at various grade levels.

Co-occurring Motor and Sensory Impairments. Many students with significant cognitive disabilities have co-occurring motor and sensory impairments that impact their ability to learn. About 11–12% of students with significant cognitive disabilities have motor impairments that require a wheelchair and/or assistance for most or all activities (Towles-Reeves et al., 2012; Towles-Reeves, Kearns, Kleinert, & Kleinert, 2009). Research fairly consistently finds that 7–10% of students with significant cognitive disabilities have visual impairments (Kearns, Towles-Reeves, Kleinert, Kleinert, & Thomas, 2011, Towles-Reeves et al., 2009; 2012) and 6–8% have hearing

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impairments (Cameto et al., 2010; Towles-Reeves et al., 2009; 2012). However, evidence suggests that these are likely underestimates. For example, studies of adults with intellectual disability report that one in three have hearing loss (Meuwese-Jongejeugd et al., 2006), and studies of Special Olympics athletes with a range of intellectual disabilities report that 19–48% have undetected hearing loss (Hild et al., 2008; Neumann et al., 2006).

Students with Complex Communication Needs

Prevalence. The presence of complex communication needs may be easier to detect in individuals with significant cognitive disabilities than vision and hearing impairments. Nonetheless, estimates of the prevalence of complex communication needs vary (Beukelman & Mirenda, 2013). For example, among students receiving special education services, estimates of complex communication needs vary from 3% in surveyed districts in Connecticut (Worah, 2011) to 12% of preschoolers in sites in Pennsylvania (Binger & Light, 2006). Among students with severe disabilities in schools in South Africa (Alant, 1999), 39% were estimated to have complex communication needs and among students with significant cognitive disabilities in the US, 37% were unable to use speech to communicate (Towles-Reeves et al., 2009). Variation in reported prevalence can be attributed in part to the focus of some surveys on the reported use of aided augmentative and alternative communication (AAC) (Worah, 2011) while others included a broader range of students with complex communication needs (Alant, 1999; Towles-Reeves et al., 2009).

Symbolic Communication. Surveys suggest that 70% (Cameto et al., 2010) to 82% (Towles-Reeves et al., 2012) of students with significant cognitive disabilities communicate symbolically. According to one study, nearly half (47%) communicate at an abstract level, 18% communicate at a concrete level, and 35% at a presymbolic level (Browder, Flowers, & Wakeman, 2008). Among students who are presymbolic, roughly half are intentional communicators (Towles-Reeves et al., 2012). Symbolic communication can be unaided (e.g., spoken words and manual signs) or aided (e.g., line drawings, tactile symbols, photographs, icons, etc.). Both unaided and aided AAC can be used at varying levels of complexity to support a variety of communicative intents. Furthermore, AAC can be used to augment spoken output or function as an alternative to speech for those persons whose output is limited to unintelligible vocalizations.

Aided AAC approaches can be broadly classified based on their reliance on additional tools and supports, which often include technology such as voice output communication devices and various commercial technologies. Twenty years ago, systems that required no technology and depended on listener support and interpretation accounted for more than 50% of aided AAC systems being used (Murphy, Marková, Moodie, Scott, & Boa, 1995). Ten years later, the most frequently used form of aided AAC system continued to be communication boards with no technology (40%), closely followed by systems with voice output (35%) (Weiss, Seligman-Wine, Lebel, Arzi, & Yalon Chamovitz, 2005). With the increased availability of commercial technologies, including a large and rapidly growing number of mobile applications, the trend continues toward increased use of technology-based systems with voice output in aided AAC.

Receptive Communication and Students with Significant Cognitive Disabilities. Communication requires both expressive and receptive skills. Among students with significant cognitive disabilities, 46% (Cameto et al., 2010) to 49% (Towles-Reeves et al., 2012) are reportedly able to independently follow one- and two-step directions presented through spoken words, sign or print. Additional supports, such as gestures, pictures, objects, or models, are needed to support comprehension by 37% (Towles-Reeves et al., 2012) to 42% (Cameto et al., 2010) of students with significant cognitive disabilities.

Literacy. Receptive and expressive language skills are required for successful literacy learning and use (Erickson, Hanser, Hatch, & Sanders, 2009). Surveys suggest that 12–33% of students with significant cognitive disabilities can read fluently with basic, literal understanding, 33–50% can read words presented individually or in simple lists or directions, and 13–35% cannot read at all (Towles-Reeves et al., 2009; 2012). These findings reflect the historical focus on sight word instruction for students with significant cognitive disabilities (Browder, Wakeman, Spooner, Ahlgrin-Delzell, & Algozzine, 2006). Only recently has there been a concerted effort to focus on the provision of instruction that addresses reading in an integrated, comprehensive manner that is required to move beyond the earliest stages of word reading (Allor, Mathes, Roberts, Cheatham, & Champlin, 2010; Erickson et al., 2009).

New academic standards in the US require educators to address reading and writing with all students (National Governors Association Center for Best Practices & Council of Chief State School Officers, 2010). Similar to the focus on sight words in reading (Browder et al., 2006), research on writing for students with significant cognitive disabilities has focused almost exclusively on writing individual letters and words (Koppenhaver, Hendrix, & Williams, 2007). However, students with significant disabilities can learn to use spelling to write for multiple audiences (Sturm, 2012) given instruction that is interactive, includes models and focuses on functions rather than forms (Erickson, Koppenhaver, Yoder, & Nance, 1997).

Communication Interventions for Students with Significant Cognitive Disabilities

Supporting the development of symbolic communication requires providing learning experiences that focus on expression, emphasize language comprehension, and, in the case of aided AAC, teach the meaning of symbols (Romski & Sevcik, 1996). Interventions reported to be effective for students with significant cognitive disabilities include approaches designed to elicit specific responses using techniques like binary choice-making with preferred and non-preferred options (Davis, Reichle, & Southard, 2000), systems of least prompts with constant time delay to teach students to point

to a specific response (Browder & Spooner, 2011), discriminant teaching strategies to teach requesting behaviors (Frost & Bondy, 2001), and the use of tactile symbols during daily classroom routines with students with multiple disabilities and visual impairments (Trief, Cascella, & Bruce, 2013). These approaches emphasize explicit, systematic teaching of specific referents. Additional recommendations focus on the use of natural teaching environments, models of aided AAC system use, and the selection of personally relevant targets to support students with significant cognitive disabilities in developing symbolic communication without continuous prompting and structured practice (Romski, Sevcik, Cheslock, & Barton, 2006). Whether modeling techniques are described as aided language stimulation (Brady, Thiemann-Bourque, Fleming & Mathews, 2013), the system for augmenting language (Romski & Sevcik, 1993), natural aided language (Cafiero, 2001), or aided language modeling (Drager et al., 2006), such practices can increase student understanding and use of symbols.

The Current Study

The use of symbolic communication is one of many characteristics of students with significant cognitive disabilities and complex communication needs that we must understand in order to develop the supports and services required to help them successfully develop language and literacy skills. The current study adds to the available literature regarding students by distinguishing between students who use speech with or without augmentation of AAC and students who use AAC as an alternative to speech. The primary research question driving this study was, Do students with significant cognitive disabilities who use aided AAC and/or sign as an alternative to speech differ in their motor, sensory, language, and literacy abilities from their peers who use speech to communicate?

Method

The Dynamic Learning Maps (DLM) Alternate Assessment Consortium developed an online survey, the First Contact Survey, in order to gather information regarding students slated to complete the DLM alternate assessment based on alternate achievement standards. The primary purpose was to inform the development of items and the delivery platform for the DLM alternate assessment (DLM, 2013). The 65-question survey distributed through Qualtrics (2013) addressed student demographics; special education placement and setting characteristics; motor skills; expressive and receptive language abilities; computer access; engagement with and attention to instruction; and academic skills in reading, writing, and mathematics.

Evidence of the reliability of the First Contact Survey was gathered in the first half of 2012. Pairs of educators with first-hand experience with individual students independently completed the survey about students with significant cognitive disabilities ($n = 299$) from seven different states. Results revealed acceptable inter-rater consistency with exact agreements ranging from .63 to above .80, and adjacent agreements at .90 and above. Intraclass correlation coefficients ranged from .579 [.498, .651] to .899 [.862, .911] (DLM, 2012).

The survey employed skip logic to present or withhold questions as appropriate (e.g., only ask about types of aided AAC systems when *uses AAC* is marked "yes"). Additionally, respondents were not required to answer every question. As a result, the number of responses available for analysis varied across questions. The survey took approximately 12–15 minutes to complete depending on the total number of items answered.

Recruitment

Educators were recruited to complete the survey by members of the DLM consortium who were employed by state departments of education in 14 states. The directive given to educators was to complete the survey for every student who would take the state's alternate assessment based on alternate achievement standards in March through June of 2013. The state departments of education were each invested in the success of the DLM alternate assessment and understood that the First Contact Survey would provide valuable data to guide the effort. Furthermore, educators were predisposed to complete all activities linked to their state's alternate assessment based on alternate achievement standards given their role in the mandated accountability system. Unfortunately, educators were not contacted directly, but via their local education agencies. As a result, data are not available to determine a response rate.

Respondents

Professionals in 14 states completed 44,787 First Contact Surveys between November 1, 2012 and May 1, 2013. While surveys were only completed for students who would take the alternate assessment in their state, the total sample included a number of students receiving special education services under eligibility categories that, by definition, preclude intellectual disabilities. For example, the IDEA (2004) definition of specific learning disability includes a statement that indicates that it does "not include a learning problem that is primarily the result of . . . mental retardation" (Statute: Title I/A/602/30). To focus the current study, surveys were excluded for students who received special education services under the following eligibility categories: (a) specific learning disability, (b) speech or language impairment, (c) emotional disturbance, (d) orthopedic impairment, (e) other health impairment, (f) hearing impairment and (g) visual impairment. While it is possible that students receiving services in these categories experience significant cognitive disabilities, they were excluded in order to focus more accurately on students whose cognitive disabilities have a significant impact on intellectual functioning and/or adaptive behavior. A total of 38,367 surveys were retained for students receiving services under the following categories: (a) autism ($n = 10{,}417$, 27.2%), (b) deaf-blindness ($n = 68$, 0.2%), (c) developmental delay ($n = 1475$, 3.8%), (d) intellectual

disability ($n = 19,575$, 51.0%), (e) multiple disabilities ($n = 6244$, 16.3%), (f) traumatic brain injury ($n = 370$, 1.0%), and (g) non-categorical ($n = 218$, 0.6%). The number of surveys completed in each state with and without the excluded surveys is provided in Table 1.

Professional role was reported on 38,367 of the included surveys. Special education teachers completed 98.4%. General education teachers ($n = 114$), paraprofessionals ($n = 47$), speech-language pathologists ($n = 38$), occupational therapists ($n = 29$), physical therapists ($n = 11$), school nurses ($n = 9$), school psychologists ($n = 20$), and others ($n = 329$) completed the remaining surveys. Most respondents reported holding Master's ($n = 20,560$; 53.6%) or Bachelor's ($n = 16,730$; 43.6%) degrees. Years of experience ranged from 0 to 30 years ($M = 12.56$, SD 9.18). The number of surveys completed by each respondent cannot be determined.

Results

Student Demographics

Gender was reported for 13,483 (35.4%) females and 24,649 (64.6%) males. The sample was roughly consistent with the racial/ethnic composition of the US, with racial and ethnic background reported as White ($n = 22,979$; 59.9%), Black or African American ($n = 9532$; 24.8%), Hispanic ($n = 2126$; 5.5%), Multiracial ($n = 1907$; 5.0%), Asian ($n = 741$; 1.9%), Native Hawaiian or Pacific Islander ($n = 80$; 0.2%), and Other ($n = 451$; 1.2%). The grade level for each of the students was fairly evenly distributed across grades 3–8 (12.6–13.3% at each grade level) when US law requires annual administration of the alternate assessment. In ninth through twelfth grades, when states determine the single year that the assessment will be administered, the distribution was more erratic (3.4%, 6.4%, 9.1%, and 2.3%, respectively).

Table 1. Number and percent of survey respondents by state in the US.

State	All surveys		Surveys retained after exclusions	
Iowa	3.5%	1550	3.8%	1471
Kansas	6.8%	3030	6.4%	2472
Michigan	17.8%	7959	15.5%	5963
Mississippi	6.6%	2953	6.6%	2518
Missouri	12.8%	5749	12.7%	4868
New Jersey	<0.02%	8	<0.02%	7
North Carolina	15.3%	6838	16.7%	6408
Oklahoma	6.1%	2754	5.9%	2269
Utah	5.3%	2375	5.4%	2056
Vermont	0.4%	200	0.4%	152
Virginia	15.7%	7018	16.6%	6353
Washington	1.9%	837	1.8%	685
West Virginia	5.1%	2305	5.6%	2135
Wisconsin	2.7%	1191	2.6%	991
Other	<0.05%	20	0.05%	19
	100%	44,787	100%	38,367

Education Settings

The vast majority of students were served in separate classrooms ($n = 25,439$; 68.9%), spending less than 40% of the day with their peers without disabilities. A chi-square test of independence (Table 2) revealed a significant relationship between the primary eligibility category and educational placement for the students in the sample, $\chi^2(30, N = 38,367) = 3294.035$, $p < 0.001$, Cramer's $V = 0.295$. All students were most likely to be educated in separate special education classrooms, and students classified with multiple disabilities were most likely to be placed in a separate school.

Students were educated in a range of urban-rural settings. Among 38,367 responses, 5619 (14.6%) attended school in a rural community (less than 2500 people), 13,242 (34.5%) in a small town (less than 25,000 people), 11,385 (29.7%) in a large town (less than 250,000 people), and 8121 (21.2%) in an urban environment (more than 250,000 people).

Student Use of Speech, Aided AAC, and Sign

Respondents were asked to report on all modes of expressive symbolic communication used by students, including speech, aided AAC, and sign. As summarized in Table 3, the vast majority of students were reported to use speech to communicate. Approximately 15.6% ($n = 5933$) of the total sample used aided AAC and/or sign as an alternative to speech, and an additional 8.5% ($n = 3241$) of the total sampled augmented their speech with aided AAC and/or sign. The remaining 9.3% ($n = 3534$) of the entire sample were not reported to use speech, aided AAC, or sign to meet their

Table 2. Educational placement: Cross tabulation of primary special education eligibility category by educational placement.

	Educational placements						
Special education eligibility category	Regular class	Resource room	Separate class	Separate school	Residential facility	Home-bound/hospital	Total
Autism	2.3% (244)	10.7% (1112)	72.7% (7576)	13.1% (1364)	0.7% (68)	0.5% (53)	100% (10,417)
Deaf-blindness	1.5% (1)	8.8% (6)	63.2% (43)	11.8% (8)	13.2% (9)	1.5% (1)	100% (68)
Developmental delay	3.1% (46)	16.5% (244)	60.1% (887)	18.8% (277)	1.0% (15)	0.4% (6)	100% (1475)
Intellectual disability	3.4% (673)	18.6% (3641)	70.7% (13,841)	6.5% (1267)	0.3% (55)	0.5% (98)	100% (19,575)
Multiple disabilities	1.8% (112)	6.9% (429)	59.6% (3720)	25.8% (1609)	2.2% (138)	3.8% (236)	100% (6244)
Traumatic brain injury	4.6% (17)	16.8% (62)	65.7% (243)	8.4% (31)	1.9% (7)	2.7% (10)	100% (370)
Non-categorical	5.5% (12)	25.7% (56)	59.2% (129)	7.8% (17)	0.5% (1)	1.4% (3)	100% (218)
Total	2.9% (1105)	14.5% (5550)	68.9% (26,439)	11.9% (4573)	0.8% (293)	1.1% (407)	100% (38,367)

Note. Numbers in parentheses reflect frequency. Regular class = education in a regular classroom with special education and related services outside the regular classroom for ≤20% of the school day; Resource room = special education and related services outside of the regular classroom for 21–60% percent of the school day; Separate class = special education and related services outside the regular class for >60% of the school day; Separate school = special education and related services in a public or private separate day school for students with disabilities, at public expense, for >50% of the school day; Residential facility = special education in a public or private residential facility, at public expense, for >50% of the school day; Homebound/hospital environment = residing in and receiving special education in a hospital or homebound program.

expressive communication needs. A follow-up question regarding the communication behaviors of the 3534 students not known to communicate symbolically indicated that 1600 (45.3%) used conventional gestures, 523 (14.8%) used unconventional gestures, and 1411 (39.9%) used reflexive, rather than intentional behaviors.

The 3534 students who were not reported to communicate symbolically were excluded from the remaining analyses. Furthermore, the 34,505 students who were reported to communicate symbolically were divided into dichotomous groups based on mode of expressive communication: (a) speech with or without AAC ($n = 28{,}572$; 82.8%), and (b) aided AAC and/or sign as an alternative to speech ($n = 5933$; 17.2%). A chi-square test of independence (Table 4) indicated a significant relationship between eligibility category and mode of expressive communication, $\chi^2(6, N = 34{,}505) = 4747.144$, $p < 0.001$, Cramer's $V = 0.338$, with speech use most likely among students eligible under the category of intellectual disability and no speech most likely for students in the deaf-blindness and multiple disabilities categories.

A chi-square test of independence (Table 5) revealed a significant relationship between education placement and mode of expressive communication, $\chi^2(5, N = 34{,}505) = 2997.269$, $p < 0.001$, Cramer's $V = 0.295$, with students who use speech (with or without aided AAC) more likely to be placed in resource room and regular classroom settings and students who do not use speech more likely to be placed in separate schools.

The vast majority of students who were reported to use sign used American Sign Language ($n = 1772$; 60.0%). An additional 1071 (36.2%) were reported to use a "hybrid or idiosyncratic/personalized signing system." A very small group was reported to use Signed Exact English (112; 3.8%). Aided AAC use ranged from touching or looking at symbols presented individually or in groups of two, to dynamic display systems with voice output. Students known to use aided AAC used an average of 1.88 (*SD* 1.19) of the systems included in the survey. Table 6 reports the total frequency and percentage of students who used each of the systems (respondents marked all that apply). Importantly, 13.4% ($n = 1062$) of students were only able to use symbols presented individually or in groups of two, and 56.0% ($n = 2558$) of the voice output devices students used offered nine or fewer messages.

Co-occurring Sensory and Motor Disabilities

Across the sample, 7.5% ($n = 2861$) of the students were unable to walk, with or without assistance. In addition, 7.0% ($n = 2688$) were reported to be blind or have low vision that was not corrected, and 4.3% ($n = 1653$) were reported to have a known hearing loss. A chi-square test of independence (Table 7) revealed significant relationships between mode of expressive communication and (a) the ability to walk, $\chi^2(2, N = 34{,}505) = 5160.878$, $p < 0.001$, Cramer's $V = 0.381$), (b) known hearing impairments, $\chi^2(1, N = 34{,}505) = 415.991$, $p < 0.001$, Cramer's $V = 0.107$), and (c) known vision impairments, $\chi^2(2, N = 34{,}505) = 1737.688$, $p < 0.001$, Cramer's $V = 0.204$), with students using speech less likely to experience motor or sensory impairments.

Language Complexity

Expressive Language. Of the 28,350 students who used speech, 19,235 (67.8%) typically combined three or more spoken words to meet a variety of communicative purposes; 6151 (21.7%) typically combined two spoken words to meet a variety of communicative purposes; and 2964 (10.5%) typically used single words to meet a limited number of communicative purposes. Even greater language complexity was suggested for students known to use speech when the group who augmented speech with aided AAC or sign was excluded ($n = 24{,}380$). In this speech-only group, 73.5% ($n = 17{,}916$) were reported to combine three or more spoken words, 20.2% ($n = 4917$) were reported to combine two spoken words, and 6.3% (1547) used only

Table 3. Speech use: Percent and total number of students with significant cognitive disabilities in the sample using each mode of communication with and without speech.

	Use speech	Do not use speech	Total
All students	75.1% (28,572)	24.9% (9466)	100% (38,038)
Students known to use aided AAC	31.5% (2497)	68.5% (5423)	100% (7920)
Students known to use sign	43.1% (1313)	56.9% (1734)	100% (3047)
Students known to use both aided AAC and sign	31.7% (569)	68.3% (1224)	100% (1793)
Students with no symbolic system	–	100% (3534)	100% (3534)

Note. Numbers in parentheses are the frequency of students in each category.

Table 4. Cross tabulation of primary special education eligibility category by mode of expressive communication.

Special education eligibility category	Uses speech with or without AAC	Uses AAC without speech	Total
Autism	78.9% (7560)	21.1% (2025)	100% (9585)
Deaf-blindness	41.4% (24)	58.6% (34)	100% (58)
Development delay	87.6% (1189)	12.4% (169)	100% (1358)
Intellectual disability	93.0% (16,793)	7.0% (1268)	100% (18,061)
Multiple disabilities	52.2% (2578)	47.8% (2356)	100% (4993)
Traumatic brain injury	82.0% (265)	18.0% (58)	100% (323)
Non-categorical	87.6% (163)	12.4% (23)	100% (186)
Total	82.8% (28,572)	17.2% (5933)	100% (34,505)

Note. Numbers in parentheses are frequency of each primary disability in each category.

Table 5. Educational placement: Cross tabulation of mode of expressive communication by educational placement.

	Educational placements						
Mode of expressive communication	Regular class	Resource room	Separate class	Separate school	Residential facility	Home-bound/ hospital	Total
Use speech with or without AAC	3.3%* (942)	17.2%* (4920)	71.1%* (20,277)	7.6%* (2185)	0.4%* (108)	0.5%* (140)	100% (28,572)
Use AAC without speech	1.1%* (63)	4.0%* (238)	62.2%* (3692)	28.5%* (1690)	2.2%* (128)	2.1%* (122)	100% (5933)
Total	2.9% (1005)	14.9% (5158)	69.5% (23,969)	11.2% (3875)	0.8% (293)	1.1% (407)	100% (34,505)

Note. Numbers in parentheses reflect frequency. Regular class = education in a regular classroom with special education and related services outside the regular classroom for ≤20% of the school day; Resource room = special education and related services outside of the regular classroom for 21–60% percent of the school day; Separate class = special education and related services outside the regular class for >60% of the school day; Separate school = special education and related services in a public or private separate day school for students with disabilities, at public expense, for >50% of the school day; Residential facility = special education in a public or private residential facility, at public expense, for >50% of the school day; Homebound/hospital environment = residing in and receiving special education in a hospital or homebound program.
* = cells with significant ($p < 0.05$) adjusted standardized residuals.

Table 6. Aided AAC systems used: Percent and number of students using aided AAC systems included in the First Contact Survey.

Aided AAC systems used	Students who use aided AAC ($n = 7920$)	
Symbols presented individually or in groups of two	49.2%	3897
Low-tech communication boards with eight or fewer symbols	28.9%	2286
Low-tech communication boards with nine or more symbols	9.5%	749
Low-tech communication book, multiple pages, eight or fewer symbols	8.8%	697
Low-tech communication book, multiple pages, nine or more symbols	9.2%	728
Eye gaze board eye gaze communication with four or fewer symbols	7.3%	581
Eye gaze board eye gaze communication with five or more symbols	1.0%	77
Simple voice output with nine or fewer symbols	32.3%	2558
Simple voice output device with 10–40 messages	5.6%	424
Voice output device with levels	3.5%	281
Voice output device or computer/tablet with dynamic display software	22.4%	1774
Voice output device with icon sequencing	4.0%	319

one spoken word at a time for a restricted range of communicative purposes.

Among students reported to use aided AAC to augment or replace speech ($n = 7699$), only 745 (9.7%) were reported to combine three or more symbols to meet a variety of communicative purposes; 1583 (20.6%) combined two symbols to meet a variety of communicative purposes; and 5371 (69.8%) used single symbols for a restricted range of communicative purposes. For students reported to use sign to augment or replace speech ($n = 2986$), 168 (5.6%) were reported to combine three or more signs to meet a variety of communicative purposes; 302 (10.1%) combined two signs to meet a variety of communicative purposes; and 2516 (84.3%) used only single signs for a restricted range of communicative purposes. Unfortunately, the survey did not ask respondents to report if or how students used symbols, signs, and/or spoken words in combination.

Receptive Language. A chi-square test of independence (Table 8) revealed a significant relationship between communication mode and the ability to respond appropriately in any modality at least 50% of the time to: (a) a favored item, $\chi^2(1, N = 34{,}505) = 7859.575$, $p < 0.001$, Cramer's $V = 0.477$, (b) phrases and sentences $\chi^2(1, N = 34{,}505) = 8106.773$, $p < 0.001$, Cramer's $V = 0.485$, and (c) two-step directions $\chi^2(1, N = 34{,}505) = 6285.669$, $p < 0.001$, Cramer's $V = 0.427$. Students who used speech demonstrated these receptive language skills much more often than their peers who used aided AAC and/or sign as an alternative to speech.

Literacy Skills. Chi-square tests of independence (Table 9) revealed a significant relationship between mode of expressive communication and (a) an understanding of the purpose of print or braille, $\chi^2(1, N = 34{,}505) = 7371.691$, $p < 0.001$, Cramer's $V = 0.462$, (b) the ability to identify individual words without symbol support, $\chi^2(1, N = 34{,}505) = 4886.007$, $p < 0.001$, Cramer's $V = 0.376$, (c) the ability to read text without symbol support but without comprehension, $\chi^2(1, N = 34{,}505) = 3301.040$, $p < 0.001$, Cramer's $V = 0.309$, and (d) the ability to read text without symbol support with comprehension, $\chi^2(1, N = 34{,}505) = 2452.029$, $p < 0.001$, Cramer's $V = 0.267$. Students who used speech were significantly more likely than their peers without speech to demonstrate each reading skill whether or not they used aided AAC or sign.

Two chi-square tests of independence (Table 10) revealed a significant relationship between mode of communication and the ability to use spelling to write (a) simple sentences and phrases, $\chi^2(1, N = 34{,}505) = 3496.957$, $p < 0.001$, Cramer's $V = 0.318$, and (b) paragraph length text, $\chi^2(1, N = 34{,}505) = 1659.352$, $p < 0.001$, Cramer's $V = 0.219$. Students who used speech were more likely to demonstrate these writing skills than their peers who did not use speech.

Discussion

The First Contact Survey was designed to support the implementation of the DLM Alternate Assessment and inform the design of items and the user interface. The current study analyzed the data for the purpose of understanding whether students with significant cognitive disabilities who used only aided AAC and/or sign to communicate differed from their peers who used speech to communicate in their sensory, motor, language, and literacy abilities. Understanding these

Table 7. Co-occurring physical and sensory impairments: Cross-tabulation of mode of expressive communication by mobility, hearing, and vision skills.

	Mobility				Hearing			Vision		
Mode of expressive communication	Walks unaided	Walks with assistance	Cannot walk	Total	No known hearing loss	Known hearing loss	Total	Normal or corrected vision	Blind or low vision	Total
Use speech with or without AAC	95.7%* (27,346)	2.2%* (630)	2.1%* (596)	100% (28,572)	96.9%* (27,686)	3.1%* (1169)	100% (28,572)	96.3%* (27,501)	3.7%* (1071)	100% (28,572)
Use AAC without speech	66.2%* (3928)	12.2%* (722)	21.6%* (1283)	100% (5933)	91.1%* (5407)	8.9%* (526)	100% (5933)	83.4%* (4950)	16.6%* (983)	100% (5933)
Total	90.6% (31,274)	3.9% (1352)	5.4% (1879)	100% (34,505)	95.9% (33,093)	4.1% (1412)	100% (34,505)	94.0% (32,451)	6.0% (2054)	100% (34,505)

Note. Numbers in parentheses are frequency of students in each category.
*Cells with significant ($p < 0.05$) adjusted standardized residuals.

Table 8. Receptive language skills: Cross tabulation of receptive language skills by mode of expressive communication for students reported to use a symbolic means of expressive communication.

	Responds appropriately in any modality to favored item >50%			Responds appropriately in any modality to phrases and sentences >50%			Responds appropriately in any modality to 2-step directions >50%		
Mode of expressive communication	Yes	No	Total	Yes	No	Total	Yes	No	Total
Use speech with or without AAC	91.1%* (26,022)	8.9%* (2550)	100% (28,572)	86.3%* (24,645)	13.7%* (3927)	100% (28,572)	73.7%* (21,068)	26.3%* (7504)	100% (28,572)
Use AAC without speech	43.4%* (2577)	56.6%* (3356)	100% (5933)	32.2%* (1908)	67.8%* (4025)	100% (5933)	19.6%* (1162)	80.4%* (4771)	100% (5933)
Total	82.9% (28,599)	17.1% (5906)	100% (34,505)	77.0% (26,553)	23.0% (7952)	100% (34,505)	64.4% (22,230)	35.6% (12,275)	100% (34,505)

Note. Numbers in parentheses are the frequency of students in each category.
*Cells with significant ($p < 0.05$) adjusted standardized residuals.

Table 9. Reading skills: Cross tabulation of reading skills by mode of expressive communication for students reported to use a symbolic means of expressive communication.

Mode of expressive communication	Understands the purpose of print or braille			Identifies individual words without symbol support			Reads text presented without symbol support but without comprehension			Reads text presented without symbol support with comprehension		
	Yes	No	Total	Yes	No	Total	Yes	No	Total	Yes	No	Total
Use speech with or without AAC	80.5%* (22,997)	19.5%* (5575)	100% (28,572)	61.5%* (17,583)	38.5%* (10,989)	100% (28,572)	47.5%* (13,577)	52.5%* (14,995)	100% (28,572)	35.8%* (10,241)	64.2%* (18,331)	100% (28,572)
Use AAC without speech	24.9%* (1475)	75.1%* (4458)	100% (5933)	11.8%* (698)	88.2%* (5235)	100% (5933)	7.3%* (431)	92.7%* (5502)	100% (5933)	3.4%* (201)	96.6%* (5732)	100% (5933)
Total	70.9% (24,472)	29.1% (10,033)	100% (34,505)	53.0% (18,281)	47.0% (16,224)	100% (34,505)	40.7% (14,008)	59.3% (20,497)	100% (34,505)	30.4% (10,442)	94.9% (24,063)	100% (34,505)

Note. Numbers in parentheses are the frequency of students in each category.
*Cells with significant ($p < 0.05$) adjusted standardized residuals.

differences is important to the design and development of resources and supports that will allow students with significant cognitive disabilities to access and learn academic standards. The survey confirmed extant research, highlighted differences between students with significant cognitive disabilities who do and do not use speech, and added information regarding the use of AAC within the population.

Consistent with Kleinert and colleagues (2015), the vast majority of students in the current study were placed in separate classrooms with less than 3% of students placed in general education classrooms with their peers without disabilities. What the current study added is the understanding that the absence of speech significantly increased the likelihood of placement in a more restrictive setting. For example, students who used speech to communicate (regardless of whether they also used aided AAC) were more than twice as likely to be placed in settings where they were educated alongside their peers without disabilities at least 40% of the school day. This increased opportunity to interact with peers without disabilities can improve literacy (Dessemontet, Bless, & Morin, 2012) and general academic outcomes (Turner, Alborz, & Gayle, 2008). In contrast, students without speech, even if they used aided AAC, were three times more likely to be placed with their peers with disabilities in separate schools where they had no access to or interaction with peers without disabilities.

The percent of students in the current sample with motor and sensory impairments confirmed the extant research (Cameto et al., 2010; Towles-Reeves et al., 2009, 2012); however, the current study also points to a relationship between these impairments and the inability to use speech. While it was not surprising to find that the students who used AAC were likely to have co-occurring motor and sensory impairments, the current study suggests that students who use aided AAC as an alternative to speech are more likely to have co-occurring motor and sensory impairments than their peers who use speech with or without aided AAC. Data confirming this relationship can inform the design and implementation of aided AAC systems to ensure they address sensory and motor access needs. The findings also suggest that the increasingly available commercial technologies and mobile applications may not fully address the needs of students with the most significant cognitive disabilities that use aided AAC as an alternative to speech. The complexity of co-occurring needs requires attention to design, access and implementation in a way that is not required to meet the needs of the population in general.

The relationship between motor, sensory, and communication impairments among students with significant cognitive disabilities also helps to explain why so few students who used AAC in the absence of speech in the current study were reported to have language and literacy skills on par with their peers who used speech. Sensory and/or motor impairments on their own can have a negative impact on language and literacy outcomes (e.g., Moeller, Tomblin, Yoshinaga-Itano, Connor, & Jerger, 2007). It has been argued that they result in a complicative rather than additive effect (Wiley & Moeller, 2007) because each additional challenge reduces the potential for compensation (Knoors & Vervloed,

Table 10. Writing skills: Cross tabulation of writing skills by expressive communication mode for students reported to use a symbolic means of expressive communication.

	Uses spelling (not always correct) to write simple phrases and sentences			Uses spelling (not always correct) to write paragraph length text		
Mode of expressive communication	Yes	No	Total	Yes	No	Total
Use speech with or without AAC	44.6%* (12,744)	55.4%* (15,828)	100% (28,572)	24.5%* (6997)	75.5%* (21,575)	100% (28,572)
Use AAC without speech	3.7%* (222)	96.3%* (5711)	100% (5933)	1.0%* (62)	99.0%* (5871)	100% (5933)
Total	37.6% (12,966)	62.4% (21,539)	100% (34,505)	20.5% (7059)	79.5% (27,446)	100% (34,505)

Note. Numbers in parentheses are frequency of students in each category.
*Cells with significant ($p < 0.05$) adjusted standardized residuals.

2003). The combination of these needs calls for an interprofessional approach to intervention (World Health Organization, 2010). Such an approach would bring together the speech-language pathologist, audiologist, teacher of the deaf and hard of hearing, special and general educator, occupational therapist and physical therapist to work in concert with family members to maximize student outcomes. The synergy created from a team of professionals who work together in an interprofessional model provides the kind of multiplicative response that is required to address the complicative needs of this group of students.

Some of the differences noted between the results of the current investigation and prior research is a result of decisions made in the design of the First Contact Survey. For example, the percent of students in the current sample considered to have complex communication needs exceeded 50%, which is higher than the 37–39% reported in extant research (Alant, 1999; Towles-Reeves et al., 2009). The difference is likely the result of a series of questions in the First Contact Survey that first sought binary responses about the use of speech, aided AAC, and signs, followed by a series of contingent questions that addressed the syntactic complexity of word, symbol, and sign use. Finally, questions probed the complexity of layout of aided AAC and type of sign system used. These questions increased the length of the survey, but provided much richer information regarding the complex communication needs of students with significant cognitive disabilities, particularly those who used speech with or without aided AAC.

For example, these questions revealed dramatic differences in syntactic complexity across modes of communication. While 68% of the students who used speech regularly combined three or more words to achieve a range of communicative purposes, only 10% of students who used aided AAC and 6% of students who used sign regularly combined three or more symbols or signs to achieve a range of communicative purposes. There are many possible explanations for this discrepancy, but instruction and access to models of other communicators using symbols or signs in more syntactically complex ways are very likely contributing factors (Brady et al., 2013). Given that nearly all of the students in the current sample are educated in separate special education settings, this information suggests that efforts need to be directed toward helping special education teachers acquire the skills necessary to provide the kinds of instruction and modeling required to develop more sophisticated syntax.

Related to this need for more sophisticated language skills, only 30% of the entire sample was reported to read text with comprehension. If students with significant cognitive disabilities are going to experience more academic success, we will need more effective approaches to literacy instruction (Erickson et al., 2009). Importantly, there was a dramatic difference in reading ability between students who did and did not use speech, regardless of AAC use. Among students who used speech with or without AAC, 36% read with comprehension and 62% read individual words. Among students who used AAC as an alternative to speech, 3% read with comprehension and 12% read individual words. While all students will benefit from more effective instructional approaches, there is a particular need to design approaches to reading instruction that address the myriad needs of students with significant cognitive disabilities who cannot use speech to communicate.

The current study suggests that we must focus more attention on the spelling and writing skills of students with significant cognitive disabilities who use aided AAC or sign but no speech. Fewer than 4% of these students were reported to use spelling to construct simple messages; however, without spelling and writing skills, these students will never be able to communicate what they want, when they want, to any partner they choose. There are no symbol sets that afford the flexibility that the alphabet and other orthographies provide. However, teaching these spelling skills cannot focus solely on mastery of the spelling of individual words because such an approach would continue to preclude the flexibility required for truly novel and generative communication. Instead, teaching these spelling skills will require interventions that integrate reading and writing, focus on function, and keep meaning at the forefront all while continuing to support students in communicating more effectively and in more complex ways with symbols and signs.

The results of the survey in the current study confirmed much of the extant research regarding students with significant cognitive disabilities. They also highlighted differences between students with significant cognitive disabilities who use speech with or without AAC and students who use AAC as an alternative to speech. There appears to be a need to distinguish between AAC use as an augmentation or alternative to speech in this population of students. This distinction is likely to inform the development of communication technologies and language and literacy interventions that better address the needs of this diverse group of learners.

Limitations

The results of the current study are limited to basic descriptive statistics and chi-square tests of independence because it used existing data from a survey originally designed for other purposes. The study is further limited in its representativeness beyond the 14 states in the DLM consortium where

it was administered. Even within these states, the applicability is limited given that response rates range from a low of eight to nearly 8000 surveys from individual states, with the majority (61.5%) returned from just four states. Given that nearly all respondents were educators, responses do not represent multidisciplinary understandings of the students. Furthermore, the current survey did not query educators regarding the types of instruction they provided or the time they invested addressing communication, language, and literacy. The use of skip logic, optional questions, and questions that asked respondents to "select all that apply" led to different numbers of responses to each question, which added complexity to the interpretation of results.

Implications

The results of the current study suggest that expansion of symbolic communication is an area of instructional need for many students with significant cognitive disabilities, with disproportionately high levels of need noted for students who used aided AAC or sign without speech. The effective use of increasingly complex symbolic communication is at the heart of academic standards that focus on college and career readiness (e.g., National Governors Association Center for Best Practices & Council of Chief State School Officers, 2010). Symbolic communication that remains limited to a small repertoire of single spoken words, symbols or signs that are used only one at a time for a restricted range of communication purposes is of limited use across academic and life domains. It is important that educators teach students with complex communication needs symbolic language representations for a variety of words and purposes while explicitly teaching students to use two and three word combinations in ways that will support language and literacy learning and academic success. To this end, language interventions for students with significant cognitive disabilities should focus on teaching the power and flexibility of words and symbols when used in combination. Practices that make use of aided language input during meaningful interactions in natural contexts across the school day hold promise for addressing areas of need. With these same language development goals in mind, broader application of aided AAC and/or sign among students known to use speech should be considered in every case that speech is limited across contexts and partners. Furthermore, reading and writing instruction should build understanding of print and how to make meaning from connected texts or write for real communication purposes. Future research investigating differences in instructional approaches and time spent addressing language, reading and writing in a comprehensive, integrated way could extend understanding of the current results.

Conclusion

The language, sensory, motor, and learning profiles of students with significant cognitive disabilities in the sample differed based on mode of communication. Significant relationships between mode of communication, categorized for analysis as use of speech with or without aided AAC or sign and use of aided AAC or sign without speech, were noted for language, reading level, writing skills, and sensory and motor abilities. The majority of students in the sample used speech to communicate and their abilities exceeded that of students known to use aided AAC or sign without speech in areas of receptive language understanding, expressive language use, reading and writing. Complexity of symbolic language use differed substantially, with the majority of students known to use speech able to combine three or more words when speaking, while the majority of students known to use aided AAC or sign were limited to the use of one symbol or sign at a time for a restricted range of purposes.

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